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Hot electron diagnostics using X-rays and Cerenkov radiation

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Abstract: The propagation of laser-generated hot electrons through matter and across narrow vacuum gaps is studied. We use the ATLAS titanium-sapphire laser of Max-Planck-Institut für Quantenoptik to irradiate 10 μm to 100 μm thick copper foils at intensities up to 10^{19} W/cm^2, generating electrons with temperatures in the MeV-range. After propagating through the target the electrons are detected via Cerenkov radiation generated in a suitable medium and by hard X-rays emitted from an X-ray "fluor". In some experiments a plastic szintillator was used to monitor the electrons. These diagnostics allow to characterize the electrons with respect to their energy, number and directionality. We also investigate the propagation of the hot electrons across narrow vacuum gaps, with a width ranging from several 100 μm down to 25 μm. The effect of self-generated fields[1] in preventing electrons to cross the gap is demonstrated. Implications of these experiments with respect to pumping of X-ray lasers[2], isochoric heating by X-rays[3] and developing optics for 4th-generation light sources will be discussed.

[1] E.E. Fill, Phys. Plasmas 8 (2001) 4613

[2] G. Pretzler, Th. Schlegel, E. Fill, and D. Eder, Phys. Rev. E 62, (2000) 5618.

[3] G. Dyer, R. Shepherd, J. Kuba, E. Fill, A. Wootton, P. Patel, D. Price and T. Ditmire, J. Mod. Opt., in print.

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